Tridyne Gas Characterization

Project Number: 95-14

Investigator: P.S. McRight/EP62

Purpose

The purpose of the Tridyne gas characterization task is: 1) to measure the rate constant coefficients for the hydrogen/oxygen catalytic reaction for use in designing catalyst beds, 2) to investigate the usefulness of Tridyne gas as a pressurant gas, and 3) to investigate the usefulness of Tridyne gas as a propellant for small thruster applications.

Background

Tridyne is a dilute mixture of hydrogen and oxygen in an inert gas (usually helium). The concentration of the inert gas is usually 90 to 95 percent by mole. The hydrogen and oxygen are present in stoichiometric proportions, i.e., the number of moles of hydrogen is twice the number of moles of oxygen. The hydrogen and oxygen may be reacted over a catalyst bed, releasing the heat of reaction and thereby, expanding the gas. As previous work has shown, the hot gas is then useful as a pressurant gas[1] or as a propellant [2 3] for attitude control thrusters. Work has also been performed on Tridyne as a possible engine ignition system.[4] Much of the published Tridyne research focused on catalysis, and bed sizes were determined empirically for each application. Empirical bed sizing makes it very difficult if not impossible to scale bed sizes for other applications. A better approach would be to determine reaction rate coefficients for the heterogeneous recombination reaction of hydrogen and oxygen. Using such an approach, catalyst beds may be sized using standard chemical reactor design techniques.

Approach

The approach is to measure the extent of reaction for a fixed bed size as a function of molar flow rate using the arrangement shown in figure 9. This data will then be reduced to determine the rate constant coefficients. The presurrant gas and propellant investigations will be performed by attaching the appropriate hardware to the test article following the completion of the determination of rate coefficients. This task is to be completed through a cooperative arrangement with the United States Army Propulsion Directorate. This arrangement has reduced the cost of the test program by allowing the use of the Army's existing test hardware.

Accomplishments

At the time of this writing, assembly of the test rig is essentially complete. Predictive analyses have been completed. NASA and Army counterparts are now in close contact, working out last minute details to ensure completion of this test program in early fiscal year 1998.

Planned Future Work

As shown in figure 10, testing is expected to be completed in the very near future, as work priorities at the Army and MSFC allow.

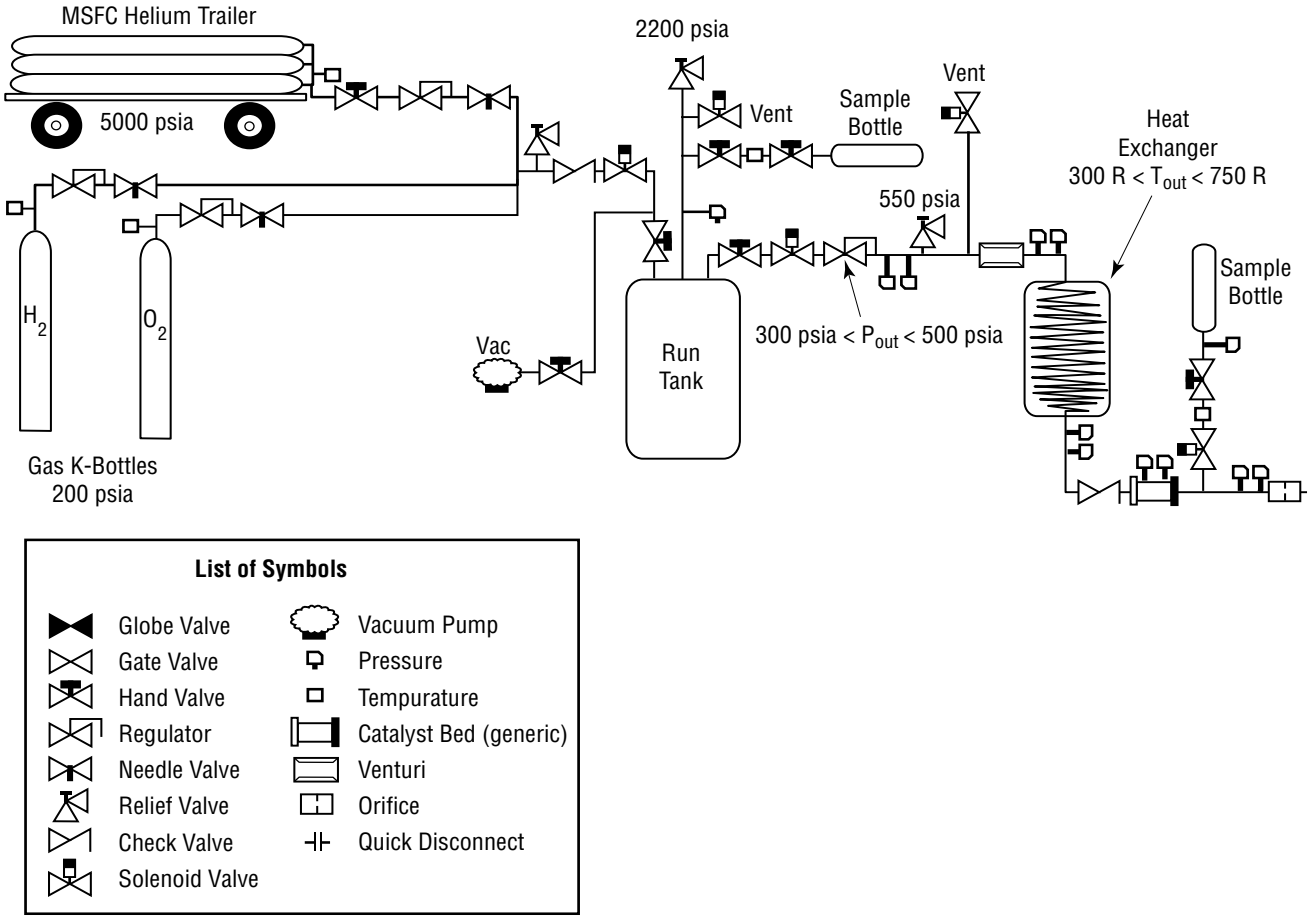

Figure 9.—Tridyne gas characterization fluid schematic for test phases I and II.

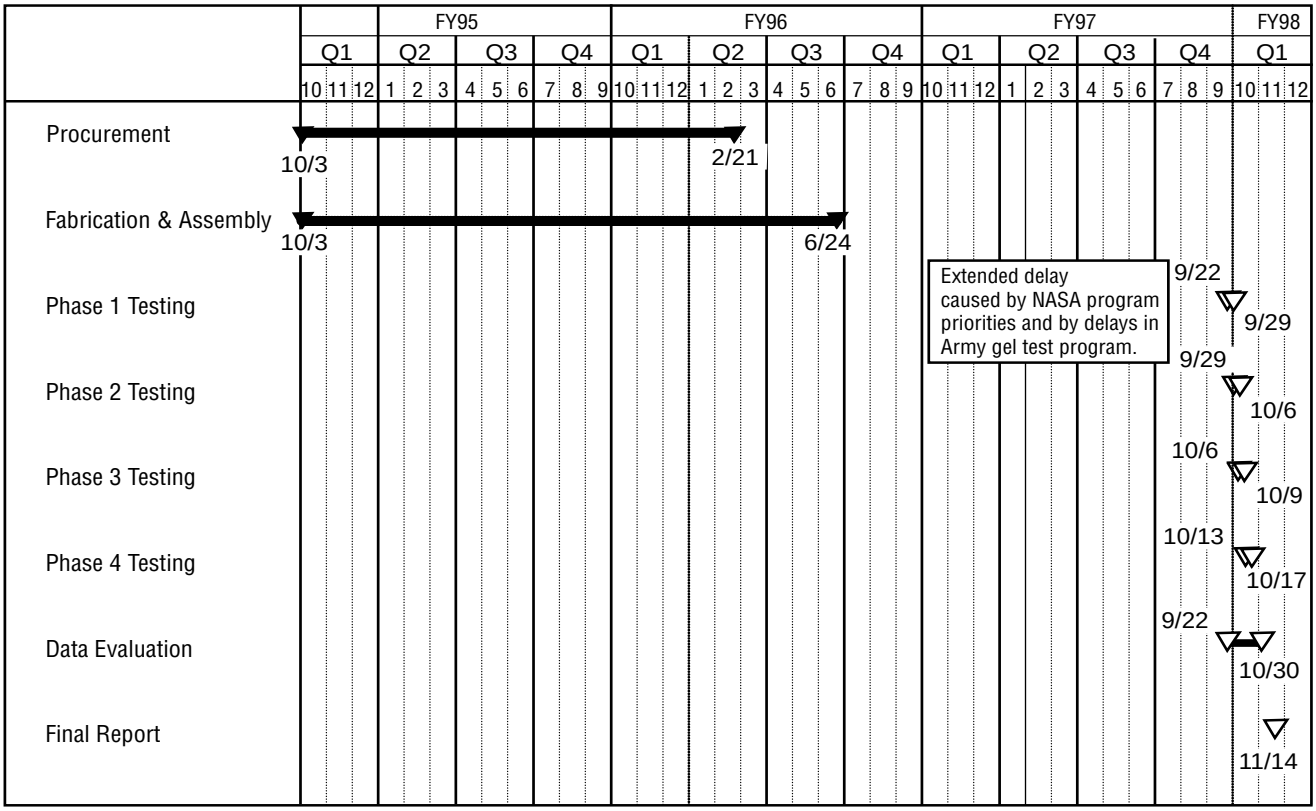

Figure 10.—Tridyne gas characterization schedule.

Funding Summary ($k)

The total funding authorized for task 95-14 is 60k. At the time of this writing, $28,056 has been obligated. The remaining funds were returned to the CDDF program during the past year. None of the obligated funds were spent on contracts or grants.

Status of Investigation

Project approved—October 1, 1994

Estimated completion—first quarter fiscal year 1998

[1]Barber, H.E.: "Advanced Pressurization Systems Technology Program Final Report," AFRPL–TR–66, 278, 1966.

[2]Rocketdyne (anonymous): "Light-Weight Advance Post-Boost Vehicle Propulsion Feed System," AFRPL FO4611–77–C–0068, 1977.

[3]Barber, H.E., et. al.: "Microthrusters Employing Catalytically Reacted Gas Mixture, Tridyne," AIAA Paper Number 70–614, 1970.

[4]Roberts, R.W., et. al.: "Investigation of Catalytic Ignition of Oxygen/Hydrogen System," NASA CR–54657, 1965.